PROCEEDINGS OF THE MONTANA CONJUNCTIVE WATER MANAGEMENT CONFERENCE

University Center

The University of Montana

June 8-9, 2009

Convenors:

The Clark Fork River Basin Task Force

Department of Geography, The University of Montana

Montana Department of Natural Resources and Conservation

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FOREWORD

On June 8-9, 2009, the Clark Fork River Basin Task Force, the University of Montana's Department of Geography, and the Montana Department of Natural Resources and Conservation co-convened a conference entitled "Montana Conjunctive Water Management Conference." The conference was held in order to examine how conjunctive management of surface and groundwater is occurring in Montana, and elsewhere in the West. It was attended by 79 registrants and another dozen non-registered people.

On June 8, the conference agenda focused on introducing the regulatory framework that Montana has in place for surface and groundwater regulation. A presentation on the Montana Bureau of Mines and Geology's Ground Water Investigation Program was also given. Finally, a panel consisting of a hydrogeologist, a water rights attorney, an environmental consultant, and the Executive Director of the Montana Water Trust discussed acquiring permits for new groundwater developments and water right changes (including instream flows). The agenda on June 9 included one panel discussion, entitled "Conjunctive Surface and Ground Water Management in Other States," followed by a break-out session during which four groups discussed assigned topics and then listed issues needing additional consideration.

The presenters were a diverse group including hydrologists, engineers, a lawyer, an environmental compliance director, a director of a nonprofit environmental organization, and a Vice President of an aquaculture company. The Administrator of the Montana Department of Natural Resources and Conservation's Water Resources Division opened the conference.

Enclosed in these proceedings are an executive summary, a summary of each presentation, and copies of the presentations. The proceedings, presentations and audio recordings are available online at:
http://dnrc.mt.gov/wrd/water_mgmt/clarkforkbasin_taskforce/default.asp.

EXECUTIVE SUMMARY

Introduction

The Clark Fork Task Force (CFTF) is a statutorily created basin water management group charged first with developing and then with proposing amendments to a water management plan for the Clark Fork River basin in Montana. The Task Force and other co-sponsors convened this conference to examine how conjunctive management of surface and ground water is occurring in Montana, and elsewhere in the West. The conference objectives were:

- To learn about the regulatory framework for water regulation of surface and ground water in Montana;
- To learn about the Montana Bureau of Mines and Geology's program funded by the 2009 Montana Legislature to collect and compile ground water and aquifer data in Montana basins;
- To learn about how conjunctive management is occurring in Idaho, New Mexico, and Washington;
- To discuss topics related to conjunctive management; determining adverse affects[1] and legal availability; determining the zone of influence for new wells; in-stream flows and conjunctive management; and Department of Environmental Quality (DEQ) public water supply and Department of Natural Resources and Conservation (DNRC) water right regulation pump requirements; and
- To identify conjunctive management issues needing additional consideration.

This executive summary, and the proceedings that follow, summarize the information presented at the conference.

Conjunctive Water Resources Management in Montana

Montana first began to regulate groundwater development in 1961. That year, the Legislature passed a groundwater code establishing a system for the appropriation of groundwater. Prior to that, groundwater could only be appropriated if it was in a "permanent, defined, and known" channel (CFTF 2008). Later, the 1973 Water Use Act required water users to obtain permits from the DNRC for groundwater developments of 100 gallons or more.

Perhaps the most significant piece of legislation came in 1991 when the Legislature recognized the significance of groundwater as a resource for Montana water users and passed the Montana Ground Water Assessment Act. The Act established the Montana Ground Water Assessment Program to characterize and monitor the state's groundwater and conduct long-term, statewide monitoring of groundwater quality and water levels. The 1991 also exempted certain groundwater developments from the

[1] "Adverse affect" comes from Montana's statutory language.

DNRC's permitting process, including wells with a flow rate of less than 35 gallons per minute (gpm) and a volume less than 10 acre-feet (ac-ft) per year.

The Montana Supreme Court decision in *Trout Unlimited v. DNRC* (2006) proved very influential for conjunctive water management in Montana. The *Trout Unlimited* case addressed applications for groundwater permits filed in the area of the Smith River (north-central Montana), which is in the Upper Missouri River Basin. The Upper Missouri River Basin was closed to the issuance of most new surface water rights in 1993, and MCA §85-2-343 defined "ground water" to mean "water that is beneath the land surface or beneath the bed of a stream, lake, reservoir, or other body of surface water and that is not immediately or directly connected to surface water." Trout Unlimited, irrigators, and outfitters filed a lawsuit against the DNRC over its intrepretaion of "immediately or directly connected to surface water". The Supreme Court ruled that in a closed basin DNRC must assess not only whether a ground water development would pull water directly from a source of surface water but also whether it would capture tributary groundwater, i.e. groundwater that would otherwise flow to surface water. This ruling halted DNRC processing of groundwater developments in closed basins.

To rectify this issue, the Montana State Legislature in 2007 passed House Bill 831. This bill required a "hydrogeologic assessment" for all groundwater permit applications in basins closed to new surface water appropriations to determine whether a new well would cause a "net depletion" to surface water sources. If the assessment predicts a net depletion, the applicant must analyze whether the depletion would cause an "adverse affect" on a prior appropriator. The applicant must submit a plan to mitigate any adverse affect, using existing water water right, acqifer recharge or other means.

Meeting the requirements of HB 831 can be extremely difficult in the case of fluvial river reaches characterized by significant channel complexity, strong surface-groundwater interactions, and highly developed irrigation works (i.e., ditch networks). Developers have chosed to avoid HB 831 requirments by drilling exempt wells in subdivisions not served by municipal water systems. Even in basins that have not been closed, the costs, complexity, and uncertainty involved in meeting permit application requirements for new groundwater appropriations has often caused developers to use the exempt well mechanism.

Montana's Ground Water Investigation Program

Competition for water resources and the lack of detailed information on groundwater/surface water interaction have challenged informed water resource management and development in Montana. Between the 2007 and 2009 legislative sessions, the Water Policy Interim Committee (WPIC) recognized the complexity and uncertainty in meeting application requirements for new groundwater appropriations, and recommended funding for a Ground Water Investigation Program (GWIP) to be conducted by the Montana Bureau of Mines and Geology (MBMG). The WPIC found that the "continued and expanded study of groundwater resources is vital to shaping statewide policy as well as providing the data necessary for local decisions regarding water (MBMG 2009)."

The 2009 legislature established the GWIP and appropriated $4.2 million, to fund six to eight GWIP projects during the 2010-2011 biennium. The GWIP will add to Montana's capability to deal with important water resource issues, including: stream depletion from groundwater development by subdivisions or irrigation programs; cumulative effects of existing and proposed water development on streamflow; impacts to groundwater and surface water from changes in irrigation practices on land use; implementation of aquifer storage and recovery in Montana; and evaluating the success of mitigation and offset plans in closed basins (MBMG 2009).

The GWIP is meant to produce three main products: a detailed report that describes a given basin's hydrogeologic system, models that simulate hydrogeologic features and processes, and a comprehensive set of hydrogeologic data available through the MBMG's Ground-Water Information Center.

Conjunctive Water Management in Other Western States

While all states in the West use the prior appropriation doctrine (first in time, first in right) to allocate rights to surface water from streams and rivers, groundwater rights are a different story. Many states have developed different doctrines to deal with groundwater rights, with varied results.

Oklahoma, Texas, and Nebraska have essentially no protection from groundwater pumping for either the environment or surface water prior appropriators. In Oklahoma, one can pump in any place, except for the actual streambed. In Nebraska, a law has allowed the city of Grand Island to drill wells on an island in the middle of the Platte River and pump water deemed "groundwater" rather than surface water.

Arizona and California continue to adhere to doctrines developed in a now discredited early 20th century water law treatise that divided underground water into dependent and independent waters. Dependent water is described as either "subflow" or "underflow," and is considered as surface water subject to the prior appropriation system. Pumping independent water, i.e. water outside the "subflow" or "underflow" region that is moving toward rivers or streams but has not yet reached rivers or streams, is exempt from regulation (Glennon 2003).

Other Western states have been more proactive about groundwater. Both Oregon and Colorado have developed bright-line tests that protect senior surface water right holders from junior groundwater pumpers. In Oregon, if an area is deemed "critical" by the Water Resources Department, the law restricts further groundwater appropriation via a well located between one quarter-mile and one mile from a watercourse. Colorado protects senior surface water diverters by a definition of groundwater that makes almost all groundwater tributary to surface flows (Glennon 2003).

The majority of Western states (Kansas, New Mexico, Nevada, North Dakota, Utah, Wyoming and Idaho) have developed an integrated priority system under which all water - surface or ground - is within the appropriation system. Therefore, any senior water user, ground or surface, will receive protection against junior users.

Six invited conference speakers discussed how conjunctive management works or does not work in three different western states. Two speakers each were invited from Idaho, New Mexico, and Washington; one guest from each state presented from the perspective of the water user, and the other from the perspective of the resource manager.

The first New Mexico presentation by State Engineer John D'Antonio discussed the state's history of conjunctive water management. He described the state's interstate compact obligations to neighboring states, and discussed how the state handles surface and groundwater interactions, and the challenges they pose. Dr. Philip King of New Mexico State University then presented a case study on the Rio Grande Project in south-central New Mexico. He discussed how the Bureau of Reclamation brokered an agreement between the states of New Mexico and Texas over surface water apportionments in the two-state project, and how groundwater appropriation is used in New Mexico as a supplementary source of irrigation water during times of shortage.

David Nazy from the Washington Department of Ecology provided an explanation and summary of water law in Washington. He explained how the state tries to examine groundwater and surface water as a single resource, and the procedures that it follows in examining water right applications. Scott Coffey of CDM, Inc. followed with a presentation on the Sammamish Plateau Water and Sewer District's Aquifer Storage and Recovery Program. Mr. Coffey discussed how the District uses water from, and recharges water to, the aquifer.

Next, Dr. Gary Johnson, Department of Geologic Sciences at University of Idaho, discussed conjunctive management in Idaho. He first focused on the science of conjunctive water management. He also touched on how Idaho's water resources authorities have attempted to model groundwater/surface water interactions. Finally, Randy McMillan, Vice President of Research and Environmental Affairs for Clear Springs Foods, offered a case study on how conjunctive water management has affected Clear Springs Foods, an Idaho trout company.

Recommendations for Improving Conjunctive Water Resources Management in Montana

Following the presentations of conjunctive management in Idaho, New Mexico, and Washington, the conference participants broke into groups to discuss topics needing additional consideration. The assigned topics were: determining adverse affects and legal availability; determining the zone of influence for new wells; instream flows and conjunctive management; and DEQ public water supply and DNRC water right regulation pump requirements.

Adverse Affects

When determining adverse affects in Montana, most of the impacts (mainly groundwater) are calculated using a computer program or calculation. The break-out group suggested that since the DNRC calculations for groundwater use assumptions that are fairly conservative, consumptive depletion should be mitigated. Also, the adverse affects should be examined cumulatively. Currently, measurable impacts do not account for cumulative impacts. Coordination with the Water Policy Interim Committee is needed on this issue.

Zone of Influence

The standard of 0.01 feet of drawdown is considered reasonable in most cases, but possibly not in confined systems because barometric fluctuations are nearly one foot in some places. Also, tools used to measure drawdown frequently are not accurate enough to measure 0.01 feet. Another problem with defining the zone of influence is the variance in the zone's size, with some exceeding 30 miles. The breakout group suggested that the Task Force should discuss the issue at some length, after which a letter to the DNRC suggesting a new standard should be sent. The group also recommended posting pumping test guidelines on the DNRC website.

Instream Flows

The instream flow break-out group determined that more information is needed to manage both surface and groundwater, and specifically the way the two interact. Some people in the group argued that if more instream flow is desired, more storage is needed. The group also discussion of considering the inclusion of ecological purposes as a beneficial use.

Pump Tests

The main issue for pump tests is that the DNRC and DEQ have different requirements for them. While both look at the physical availability of water for wells, the flow rate requirements are dissimilar. Currently, the DEQ is entertaining changes to pump test requirements that would make them similar or identical to the DNRCs. The breakout group discussed reducing the domestic well exemption to increase the number of permit applicants. Since HB 40 is supposed to streamline the permitting process and direct the DNRC to provide upfront an opinion of the likelihood of the permit's approval, seeking a permit for a domestic water source may be a more attractive option. The group also discussed water banking as a possible solution for community water supplies to purchase existing water rights.

Introductory Session – Setting the Stage

Montana Regulatory Framework – John Tubbs

John Tubbs, the Water Resources Director for the Montana Department of Natural Resources and Conservation (DNRC), introduced Montana's framework for water regulation for surface and groundwater. The DNRC is one of several state agencies that regulate water in Montana. The Department of Environmental Quality (DEQ) regulates water quality and domestic water supplies, the Department of Fish, Wildlife & Parks (DFWP) handles fish protection issues, and the Montana Bureau of Mines & Geology (MBMG) focuses on groundwater science. The Department of Agriculture also deals indirectly with water issues, primarily regarding agricultural chemicals and irrigation.

Brian Shovers, in his April 1, 2005 article for the magazine *Montana; The Magazine of Western History*, mentioned a story of two water rights analysts in 1980 on a field investigation for the DNRC in the Bitterroot Valley. An irrigator requested an inspection of a newly constructed pond diverting water from a ditch. As the analysts approached the property, the landowner fired three rounds of rifle fire overhead. This incident demonstrates the contentiousness of administering water law in a state populated with many property owners suspicious of any mandates coming from the State Capitol.

When Montana became a state, political subdivisions were based on a range and township coordinates rather than watershed boundaries. As a result, the state failed to establish a water management system that recognized water as a scarce resource.

In 1972, the Second State Constitutional Convention recognized and confirmed all existing rights to use any water for a useful or beneficial purpose. Article 9, Section 3 of the Montana Constitution states that, "All surface, underground, flood, and atmospheric waters within the boundaries of the State are the property of the State for the use of its people, subject to the appropriation for beneficial use, as provided by law." The use of that water is held as a property right in the state.

Water right regulation is the subject of Chapter 2 of the Montana Water Use Act. In 1973, the Water Use Act set July 1, 1973 as the date after which new water uses must be permitted by the DNRC. Before that date, all one had to do to establish a right was to divert water and put it to a beneficial use. The Water Use Act also established the DNRC as the central repository of water right information.

In 1979, the Water Use Act was amended to establish the statewide water right adjudication. It required all pre-1973 water right holders to file water right claims, directed the DNRC to examine the claims, and created the Water Court to adjudicate the claims. The adjudication in Montana is especially difficult because it must address over 350,000 claims, a large number of water right compared to other western states.

Most of Montana's water policy is focused on surface water. Prior to passage of the basin closure statutes, groundwater was treated as a separate resource, and the connections between the two were barely recognized. The passage of the closure statute in the early 1990s began to set the stage for conjunctive management in the state. The closure statute reflected the realization that basins were over-allocated. It also authorized the DFWP to hold and enforce instream flows to protect the fishery in certain "blue ribbon" trout streams. The landmark case *Trout Unlimited et al.* v. *Montana Department of Natural Resources and Conservation* (2006) prohibited the DNRC from accepting groundwater applications in most closed basins because of groundwater-surface water interactions.

House Bill 831 (2007) established a new procedure to appropriate groundwater in closed basins. It required a hydrogeologic assessment with new permit applications to ensure no adverse affect on senior water right holders. The bill was predicated on upfront mitigation to offset the new consumption of groundwater and avoid surface water impacts to senior water right holders.

The 2009 Legislative Session enacted two bills with significant impacts on conjunctive water management in Montana. House Bill 40 set up a water right process that is easier to negotiate for both the applicant and the DNRC. In the pre-HB 40 process, the DNRC did not issue its finding about the compliance of an application with statutory approval criteria until all parties had spoken. The DNRC decisions, therefore, often surprised both the applicant and objectors, even when all parties had worked out their differences and expected the application to be approved. HB 40 sets up a process in which the DNRC will issue a Preliminary Decision Document to inform applicants upfront of its judgment of whether or not the statutory permitting criteria have been met and the application will be granted or denied.

House Bill 52 establishes a groundwater investigation program. This marked the first time the state has invested a significant amount of money to systematically model groundwater–surface water interactions. This modeling will improve the DNRC's ability to grant or deny permits based on adverse affect in closed basins.

Mr. Tubbs concluded by saying that Western water law (the prior appropriation doctrine itself) is being tested because of growth, interconnectivity of groundwater and surface water, and the fact that this system does not really work well for conjunctive water management.

Ground Water Investigation Program – Dr. John Metesh

Dr. John Metesh is the Research Division Chief of the Montana Bureau of Mines and Geology (MBMG; or Bureau) and a Research Professor at Montana Tech of The University of Montana. He presented an overview of the Ground Water Investigation Program.

The MBMG is a non-regulatory state agency; technically it is a department of Montana Tech. However, MBMG does participate in geologic and hydrogeologic decisions made by the state.

The MBMG has several areas of focus: geology, ground water studies, environmental studies, ground water monitoring, research analytical labs, and publications/Geographic Information Systems (GIS).

In the area of geology, the MBMG focuses on several projects and programs, including cooperative mapping program with the U.S. Geological Survey, mining and minerals (the MBMG runs a small miner's program), and an Earthquake Studies Office. In terms of natural resources, the MBMG's focus is on coal availability/coal bed methane (CBM), petroleum, geothermal energy (House Bill 333 set up a geothermal research program in MBMG), and sand and gravel (Senate Bill 297 established a sand and gravel mapping program within the Bureau).

In the groundwater studies area, the MBMG has the Ground Water Assessment Program, the Renewable Resources Grants /Resource Development Grant Program through the DNRC, and the 312 Brownfields Grant Program through the Department of Environmental Quality (DEQ).

For environmental studies, the MBMG focuses on Superfund sites, the Natural Resource Damage Assessment, and the United States Forest Service/Bureau of Land Management (Abandoned Inactive Mines-Abandoned Inactive Placers).

In the area of ground water monitoring, the MBMG takes care of issues related to GWAMON (a statewide groundwater monitoring program), Superfund, the Controlled Groundwater Area in Yellowstone National Park, and monitoring of coal strip mining and coal bed methane operations.

The research analytical labs employ research chemists that focus on both inorganic and organic chemistry, along with pharmaceuticals.

Finally, the MBMG publishes traditional/historic documents, online/digital products, and maps and reports.

The MBMG performed a case study of closed basins in Montana. The study started in 1993 with the closure of basins due to over-appropriation. The Trout Unlimited decision went into effect in 2006, which established the connectivity between ground and surface water, effectively changing the permit process for new groundwater-based water rights. In the 2007 Legislative Session, House Bill 831 set up the requirement of doing a hydrologic assessment, along with setting up an evaluation of a mitigation and offset plan. House Bill 304 set up the Water Policy Interim Committee to evaluate water issues (among them, stream depletion) and set up the MBMG's case study of closed basins. The case study evolved into three individual studies, examining stream depletion at three different scales (basin-scale water balance, groundwater flow, and a sub-basin-scale model). The MBMG examined the stresses on the system that would cause or offset stream depletion, along with the hydrologic conditions in which stream depletion would occur. Some of the stresses include evapotranspiration, recharge, proposed pumping, existing pumping, and mitigation/offset. An important conclusion from the study was that stream depletion may take a long time to occur.

The Water Policy Interim Committee requested House Bill 52, which directs the MBMG to conduct one-to three-year focused investigations of ground and surface water in high-growth (or over-appropriated) areas. It also adds a member of the development community for the Ground Water Assessment Steering Committee (GWASC). Finally, it directs the GWASC to prioritize sub-basin investigations based on anticipated growth in housing, agriculture, industry, and commercial activity.

The GWIP has three main products: a detailed report that describes the hydrogeologic system, models that stimulate hydrogeologic features and processes, and a comprehensive set of hydrogeologic data available through the MBMG Ground Water Information Center.

A non-inclusive list of MBMG project types includes stream depletion from groundwater development by subdivisions or irrigation projects, water quality impacts from development by subdivisions or irrigation projects, cumulative effects of existing and proposed water development on stream flow, impacts to ground water and surface water from change in irrigation practices or land use, implementation of aquifer storage and recovery (ASR) in Montana, and evaluating the success of mitigation/offset plans in closed basins.

The GWASC guides the GWIP. Its voting members include the DNRC, the DEQ, the Department of Agriculture, and the State Library. There are also ex officio members from: the Legislative Services Division; the Board of Oil and Gas Conservation; the MBMG; a unit of the university system; a county government; a city, town, or city-county government; and principal federal agencies. The Committee also has members appointed by the governor, representing agricultural water users, industrial water users, a conservation or ecological protection organization, and the development community. In the fall of 2008, the GWASC developed preliminary selection criteria for the HB52 studies, as well as a list of sub-basins. The selection criteria were finalized in the spring of 2009, along with a prioritization of sub-basins. The selection process is based on sub-basin size, how much can be accomplished in the basin in 1-3 year studies, and the level of funding.

In prioritizing study areas, the GWASC examines the sub-basins for high growth rates, new wells, impaired water quality, and expansions of industrial and agricultural water use. The Committee also notes if the sub-basin is in a closed basin, and the flood-to-sprinkler conversion rate. Secondary characteristics taken into consideration include population density, usability of the water, previously-known information, the complexity of the system, availability (or existence) of a county growth plan, mitigation water availability, basin fill versus bedrock, efficiency of effort, and diversity. The Committee also examines how litigious the water users are in the basin, along with whether the sub-basin is in a highly-valued ecological water system.

Ground Water Assessment Program - Thomas Patton

Thomas Patton is a Senior Research Hydrogeologist and the Program Manager for Groundwater Assessment for the MBMG. He presented information about the Ground Water Assessment and Ground Water Investigation Programs.

In the late 1980s, the GWASC examined groundwater studies of the past 40 years. All of the studies were site-specific and non-systematic. In 1991, the State Legislature took action and established the Ground Water Assessment Program (GWAP), finding that: Montana’s citizens depend on groundwater for a variety of uses; the supplies and quality were threatened; there is insufficient information characterizing the volume, quality, and flow patterns of the state’s groundwater; and better groundwater information is required (MCA §85-2-902). The GWAP was established to improve the quality of groundwater management, protection, and development decisions within the public and private sectors by establishing a program to systematically assess and monitor the state’s groundwater and to disseminate the information as appropriate (MCA §85-2-902).

Also in 1991, the Legislature created the Ground Water Information Center to distribute information and the Ground Water Characterization Program to perform systematic assessments of groundwater~~,~~ and conduct groundwater monitoring. With the passage of HB 52, the 2009 Legislature provided a funding source for focused issue-specific groundwater studies.

As of the date of the Conjunctive Management Conference, GWIC has completed the Ground Water Characterization Atlas for the Flathead Lake and Lower Yellowstone areas. Other maps are being completed for the Lolo-Bitterroot and Middle Yellowstone areas. Mapping is underway in other areas. Across the state, around 8,300 wells have been visited, with about 1,900 samples collected. The data collection creates a data set that contains the organic and inorganic chemical content in various locations across the state.

For groundwater monitoring, 914 monitoring wells across the state record water quality and water quantity. The MBMG is trying to build a long-term hydrograph and long-term water quality history at each of those wells. All of that information is entered into the Ground Water Information Center, which is accessible online at http://mbmggwic.mtech.edu. Well logs, scanned documents, maps, hydrographs, and water quality information are available through the website.

Panel Session 1 – Acquiring a Permit for New Ground Water Development

Consultants' Perspective – Overcoming the History of Technical Protocol When Obtaining New Appropriations in Montana – Randy Overton

Randy Overton is a hydrologist with RLK Hydro, a hydrology firm based in Kalispell, Montana. His work has addressed a variety of groundwater issues and has encompassed both water quantity and quality issues associated with mining, hazardous waste problems, subsidence, and water resource development. He gave a presentation on overcoming the problem of maintaining the status quo in groundwater analysis and permitting.

A protocol always develops in obtaining a permit. Overton said that understanding the evolution of that protocol is always useful. A preference develops for using simple analytical methods for finding water, and the methods become implied in statute. Ill-defined statutory terms create problems, especially regarding water law. Luckily, the DNRC is flexible in overcoming protocol, but one has to justify why they are breaking with commonly accepted practices.

There is a general shift in the western part of Montana from agricultural water use to municipal use, often tapping aquifers not located in the valley centers. These aquifers are located in valley fringes and may not be the best place to find water.

C.V. Theis and C.E. Jacob are two pioneers in predictive methods of finding groundwater sources. Both of them relied on Meinzer, who was an early investigator of the United States Geological Survey (USGS). Theis recognized Meinzer's work on both the confining layer and captured water as a source. Theis' interest was in laterally-bound valley aquifers of New Mexico, and focused on captured recharge, diverting discharge, and stream depletion. Jacob was a contemporary of Theis, but focused on water from confining unit storage. He recognized the elastic nature of aquifers and that lag time is associated with drainage. The largest problem areas back in the 1940s (when Theis and Jacob were performing research) were yields from aquifers, the rate of flow, drawdown at the well, and hydrological prediction. After the 1940s, more sophisticated hydro-science developed, especially on aquifer performance, recharge in multiple-well environments, and water transport. Meinzer became a footnote, and little thought was given about the sources of water released to wells.

Determining the zone of influence for wells is difficult because it is dynamic. Legal availability focuses on whether water is available in the face of existing appropriations. The zone of influence determination is based on a 0.01 foot drawdown after one year of pumping. However, since most people use the Theis/Jacob method by calculating against a static condition, the zone of influence is over-estimated. Seasonal recharge is not accounted for in these methods. Another problem is that some methods may account for release from storage, and do not always provide a stable solution. Legal availability is calculated using flux and existing appropriations. Flux is calculated by:

Flux = Zone of Influence width x Gradient x Transmissivity.

It is based on static conditions, and on volume, not transient demand.

In the Northwest, many aquifers are characterized as high transmissivity–low gradient aquifers. Their calculated flux may be low under transient conditions. Another problem is that for low transmissivity–high gradient aquifers, the actual flux possible under stressed conditions is limiting.

Physical availability is based on the theoretical drawdown after one year of pumping. It is based on static conditions and a single well influencing the aquifer, rather than multiple wells. Not accounting for cumulative effects is a problem, especially in areas with multiple wells. While this may be acceptable for large aquifers, under stress conditions low water availability can appear in aquifers with low transmissivity.

In aquifers with high transmissivity, the zone of influence is a very large and flat. In densely populated areas with high appropriations, showing volumes of water that are legally available may be difficult. Conversely, in low transmissivity aquifers there is a potential for system dewatering, even though the aquifers pass the test based on zone of influence. The excessively simplified assumptions hydrologists use to calculate physical and legal availability create problems, including prediction errors in timing and rates of depletion. That being said, the DNRC has been open to variation from basic evaluation, as long as the variations are well justified and based on a strong conceptual model.

Alternatives to traditional legal and physical availability evaluations involve thinking beyond static evaluations. When modeling, systems should be treated as dynamic. The water source should be accounted for, along with recharge. Previous methods may be blended, such as Theis', Jacob's, and Meinzer's.

Terazaghi worked with soils and drainage. His work leaves one with the impression that when one starts to dewater confining units, one uses the capacity of the confining unit to rebound and store water again. This is only true in extreme dewatering events. An alternative method of accounting for water and water availability involves using an approach developed by Konikow and Neuzil (2007) which looks at water released from confined layer storage. When water is released from an aquifer and enters a well, the zone of influence shrinks. The method allows recharge to be accounted for, and appropriation density may not be a problem as it is in other methods. The confining unit drawdown is calculated in a dimensionless form

$$\Delta h/\Delta H$$

where:

h = head in aquifer, and

H= head in confining unit (average value).

Then, for the condition when $\Delta h/\Delta H$ is around 1.0, a virtual drawdown that develops within a confining unit, z_d (distance/length), may be evaluated. If z_d is less than the confined unit thickness, then a thick confining layer exists. To solve for z_d:

$$Z_d = (Kt/S_s)^{1/2}$$

where:

K = confining unit hydraulic conductivity,

t = time, and

S_s = specific storage of the confining unit.

The volume of water (V_w) from the affected confining unit may be calculated using

$$V_w = S_s z_d A \Delta H$$

where A is the confining unit affected area supplying water and may require an iterative process to cross-check and confirm the estimate. A can be determined and checked by setting V_w to the pumped volume. A represents the confining unit zone of influence. Using the Konikow and Neuzil method, the zone of influence is markedly smaller than with the current practice. Annual recharge can be estimated using historic hydrographs.

Alternative methods provide more accurate estimates of available water. They can also provide more reasonable estimates of effects in complex systems, some of which have boundary conditions, multiple aquifers, and fractured bedrock – dual porosity systems. This also eases the credibility determination for the DNRC.

Permitting Issues for Municipal Water Suppliers – Ross Miller

Ross Miller is a water rights attorney in Missoula. Prior to becoming an attorney, Miller was a hydrologist and environmental engineer in Missoula. His practice deals with water law-related property matters, environmental law, and real property and business transactions. His clients include Mountain Water Company, the municipal water supplier to Missoula.

Municipal water suppliers don't have the water rights they think they have, and are going to be leveraged in permitting situations more frequently and faster than they realize. Any time a municipal water supplier (with a municipal water right) wants to make a change in a municipal water right, they will bump into the following DNRC rule, effective January 1, 2005: "The amount of water being changed for each water right cannot exceed or increase the flow rate historically diverted under historic use, nor exceed the historic volume consumptively used under the existing use." Every water right will be analyzed for historical consumptive use. The rights may be trimmed back depending on the results of that analysis, with no additional water reserved for future growth of the municipality.

Municipal suppliers commonly need to make changes to their water rights, a key difference separating municipal water rights from other water right types. Three circumstances that may create the need for a water change are; increases in the supplier's service area, a need to add a well in order to efficiently distribute water, or the addition of storage capacity.

In making such changes, the DNRC can "trim back" the municipal water supplier's rights, so that they cannot provide for growth. Municipal suppliers will also likely have to forfeit any post-1973 increased use of pre-1973 rights, which the municipal water suppliers have relied upon for over 30 years. The trimming back of water rights established before 1973 nullifies any protections required of the Water Court under MCA §85-2-227(4), essentially nullifying the statute itself. That statute states that a water right claimed for municipal water use is presumed to not be abandoned if any part of the water right is used for municipal water supply.

Under the language of the Administrative Rules of the State of Montana (ARM) 36.12.1902(2), the DNRC can limit a water right change to the amount historically consumed, not the amount historically diverted. The amount consumed is often less than ten percent of the amount pumped. Much municipal water use is returned to groundwater or surface water through sewage treatment works, and may not be considered "consumed."

The State of Montana has not adopted a Municipal Growth Doctrine, a doctrine that most western states adhere to in some form. The doctrine recognizes that as municipalities grow, their water consumption grows, and municipal water rights should accommodate the growth. Essentially, the DNRC's policies and current interpretation of Montana's Water Use Act has created a "no new connections doctrine" for municipal water use in Montana. This "doctrine" results in municipal water suppliers being forced into acquiring new permits for any growth. In many basins, this requires the purchase of mitigation water. In other words, municipalities that believe they have ample water rights for some reasonable growth will find they have none whatsoever, and must acquire new permits under the expensive process of mitigation, as required by the 2007 House Bill 831.

Miller said that municipal water rights should be recognized as different from other water rights. Municipal suppliers have little control over growth, and cannot stop it. As municipalities grow, water use grows. If this difference is not recognized, growth will be limited to outlying areas with exempt wells.

Colorado has recognized that municipal water rights must allow for reasonable growth since 1939. Wyoming law allows municipalities to incrementally develop their water rights. New Mexico recognizes that municipal water rights cannot be limited to historical use, and instead must allow for growth. Idaho and California have both specifically protected municipal water rights from forfeiture for lack of historical use when they are held in anticipation of future needs. In other words, the unused portion of the water rights aren't classified as abandoned.

Water Rights from an Applicant's Perspective – Kevin Germain

Kevin Germain is the Director of Planning and Development and Environmental Compliance at Moonlight Basin, located at Big Sky, Montana. His work experience includes resort and real estate planning, and technical applications of environmental and civil engineering. Previously, he worked for Land and Water Consulting in Bozeman.

Moonlight Basin intends to become a four-season resort community, with 1650 residential units and 1200 employees (300 year-round) at build-out. The amenities of the resort include skiing, golf, trails, fishing, and wildlife. It is located in the Greater Yellowstone Ecosystem. Moonlight Basin aims to be "stewards of the land." The original purchase for the ranch was 25,000 acres, of which 85% will be protected.

In December 2004, Moonlight Basin's privately owned, publicly regulated utility company, Treeline Springs, applied to the DNRC for three wells for 250 homes, golf course and residential irrigation, and snowmaking. The wells totaled 163.2 acre-feet/year in volume. The DNRC published a public notice of the application in May 2005~~,~~ The public comment period closed the following month. DNRC received one objection to the application from a neighboring ranch. Moonlight Basin reached an agreement to resolve the objection the following year. However, in April 2006, the Montana Supreme Court issued the *Trout Unlimited* decision and it subsequently created difficulty for Treeline Springs. With the passage of HB 831, Treeline Springs submitted a mitigation plan with the change application to the DNRC based on a water right option purchased from a downstream irrigator. In February 2008, DNRC issued the permit for the wells with conditions. The conditions included issuance of a change authorization from the DNRC needed to be issued. The change application was noticed publicly in April 2009, One objection was filed before the public notice period closed. Treeline Springs is working with the objector to resolve the objection.

Moonlight Basin/Treeline Springs has faced a continually changing permit process, which delayed the approval of the wells. Germain recommended improving the process by making it more predictable and faster with established timelines. He advocated developing a streamlined process through close coordination between municipalities, counties, developers, DFWP, Trout Unlimited, irrigators, power generators and the DNRC. He expressed hope that HB 40 will help to improve the process. Germain supported a mind-shift away from the exclusive protection of existing users and towards wise allocation. He also recommended water banking by which pooled resources could make water easier to manage rainwater harvest and reuse of treated effluent water.

Germain warned that not fixing the permitting process risks slowing growth in Montana. Capital from outside the state could become hesitant to invest here. The lack of growth could hurt local government and schools, reducing the tax base.

Conjunctive Management and Leasing Consumptive Water Rights for In-stream Flow: An Applicant's Perspective – Barbara Hall

Barbara Hall is the Executive Director of Montana Water Trust in Missoula. She also functions as the Staff Attorney. She discussed the experience of applying for a water right change permit for in-stream flows.

The Montana Water Trust is a non-profit organization founded in 2001 to develop cooperative, incentive-based streamflow restoration solutions. It is one of three private organizations in Montana that lease consumptive water rights for in-stream flow. One example of the solutions that the Water Trust pursues is split-season leasing, in which irrigators irrigate only in the beginning of the season to augment flows later in the year.

Four mechanisms exist in Montana for maintaining or restoring instream flow. Pursuant to a 1969 statute, the Montana Department of Fish, Wildlife (DFWP) and Parks established Murphy Rights the same year on 12 blue-ribbon trout streams in the state. While these rights enable DFWP to maintain habitat protection, their junior priority dates render them ineffective at restoring stream flow. The Montana Water Use Act allows for public entities to reserve waters for in-stream use. Basins can also be statutorily or administratively closed to further appropriation to protect in-stream flows. Finally, water rights can be temporarily changed to protect and restore in-stream flow through leases or conversions.

The Water Trust must satisfy several requirements to lease water for instream flows. It must obtain a water right change permit. In-stream flow change applications are subjected to the traditional historic and consumptive use analysis, finding the length and location of stream reach where stream flow is meant to be protected, and determining the amount of water needed for the fishery resource. They must also include a detailed stream flow measuring plan. The DNRC is also developing in-stream flow rules.

Hall referenced MCA §85-2-408(7), which states that, "The maximum quantity of water that may be changed to maintain and enhance stream flows to benefit the fishery resource is the amount historically diverted. However, only the amount historically consumed, or a smaller amount if specified by the department in the lease authorization, may be used to maintain or enhance stream flows to benefit the fishery resource below the existing point of diversion." The Water Trust is struggling with the interpretation of the phrase "amount historically consumed," as it involves such components as historic irrigation, evapotranspiration loss, deep percolation, and return flow.

The Water Trust must delve into the world of groundwater-surface water interactions to conduct the adverse affects analysis required for change applications. This analysis requires understanding irrigation efficiency and return flows, identifying gaining and losing stream reaches, and determining the overall plumbing of an area. All change applications must show the effects on other water rights including those dependent on return flows, and the effects of changing the historic diversion pattern including the rate and timing of depletions. Irrigation return flow studies need to determine the amount of irrigation water that recharges the aquifer, the location, amount, and timing of return flow to the stream.

Hall said that funding is generally lacking for studies of groundwater-surface water interaction to determine the most efficient location for putting water back into the stream. Two examples of studies that have occurred addressed the Little Blackfoot River and Dry Cottonwood Creek. On the Little Blackfoot River, synoptic flow measurements were taken to identify future leasing opportunities by determining discharge upstream and downstream of the Water Trust's project area and quantifying inflows and outflows. Another groundwater-surface water interaction study is focusing on water management and the potential on the Dry Cottonwood Creek Ranch to convert irrigation water into in-stream flow in dewatered stretch of the Clark Fork River.

Other challenges for the in-stream flow applicant include determining the amount historically consumed downstream from the historic point of diversion; the need for permanent changes to mitigate the impacts of new development; the uncertain water market in Montana due to the lack of a water right adjudication; and the unknown role-exempt wells play in affecting in-stream flows. Hall also mentioned that the expense and time required to get a change flow application is "very daunting," and the enforcement of existing water rights leaves something to be desired.

Hall listed several desires for the future. A full analysis of current and future groundwater development is needed to inform the Water Trust's projects. She suggested the possibility of using aquifer storage and recovery for in-stream flow augmentation, as well as leasing existing groundwater rights, having a more sophisticated and formalized water marketing regime, and having more contracting for stored water for in-stream flow. Hall added that the Montana Water Trust will probably participate as objectors in future groundwater permit applications.

Hall said that conjunctive water management is critical for protecting instream surface flows and maintaining groundwater discharge as part of the flow regime.

Panel Session 2 – Conjunctive Water Management in Other States

New Mexico

John D'Antonio

John D'Antonio is the State Engineer in New Mexico. He is a registered professional engineer in both New Mexico and Colorado. He has experience in hydraulic design, acequia rehabilitation, water resource management, and water policy development. In 2002, D'Antonio was Cabinet Secretary of the New Mexico Environment Department. He served as the Director of the Water Resources Allocation Program for the Office of the State Engineer from 2001-2002, and served as the District 1 Supervisor for Albuquerque from 1988-2001. Mr. D'Antonio also worked for 15 years for the Army Corps of Engineers as a hydrologic design engineer.

Around 350 personnel in the State Engineer's office manage all water quantity and water rights permitting issues. The water resource allocation program has seven water rights offices across the state. The State Engineer's Office also includes a Water Use, Conservation and Hydrology Bureau and the Litigation Adjudication Program that adjudicates water rights within the state of New Mexico.

Mr. D'Antonio mentioned that New Mexico is the second-driest state in the United States.

New Mexico is part of eight interstate compacts, that address the Rio Grande and Pecos Rivers and the Colorado and Canadian Basins. For the Rio Grande and Pecos River Compacts, the state has water delivery requirements to the state of Texas.

New Mexico manages 4 million acre-feet of water annually. Around 2.1 million acre-feet of that amount is surface water. The surface water code has been effective since 1907, five years before statehood. Since 77% of the water used in the state is used for agriculture, New Mexico has room to grow. However, the state doesn't always have water where the growth is. Half of the state's population resides in the Middle Rio Grande Basin, which makes it challenging for the state to deliver enough water for the population.

In 1931, New Mexico started appropriating groundwater by permit under the State Engineer's jurisdiction.

In 1956, permits were required for using water in the Middle Rio Grande sub-basin. Many wells were established before 1956 and information about how water is used from those wells is lacking.

Conjunctive management in the state of New Mexico began in 1956 when the State Engineer ruled on an application from the City of Albuquerque requiring the city to retire its surface water rights to offset the effects of city well pumping on the Rio Grande River. Since that ruling, water rights and stream-related groundwater basins in the state have been administered based on the effects on surface water.

Applicants for a change of use permit must file a notice of their application once a week for three consecutive weeks. A ten day protest period and a hearing process follow. The State Engineer then approves, denies or partially approves the application. Parties aggrieved by the decision may appeal it to a state district court. When evaluating an application, the State Engineer considers impairment of existing uses, effects on conservation, and detriment of public welfare. In Montana the burden of proof of adverse affect falls on the applicant.

In 1943, the State Engineer filed an order that eliminated the requirement of publishing a notice for domestic wells up to three acre-feet (equivalent to exempt wells in Montana) because the requirement had become administratively burdensome for the relatively small amounts of water. In 1952, the legality of the order was questioned, and new legislation was adopted in 1953 that allowed for preferential treatment of domestic wells. In August 2005, the State Engineer's office lowered the domestic well maximum volume to one acre-foot per year. The office was also allowed to set up domestic well management areas that will reduce the one acre-foot limit to 0.25 acre-feet, or require water rights to be transferred into those wells.

By 1988, after a period of 34 years, New Mexico was under-delivering water to Texas by 10,000 acre-feet a year on average, because of over-appropriation in the Pecos River basin. Texas sued New Mexico for $1 billion, but the U.S. Supreme Court ordered New Mexico pay only $14,000,000 in damages. It also ruled that if New Mexico continued to under-deliver water to Texas, the federal government would appoint a federal water master to manage water appropriation in New Mexico. In the late 1990s, around $30 million was spent on short-term leases to accommodate for water withdrawals in the Pecos River basin. The state came critically close to not making the water right deliveries to Texas. To fix the over-appropriation, the solution was to take 18,000 acres of farmland out of production; it was taken out into two stages and the state spent $70 million to purchase these lands and/or water rights and subsequently retire them from agricultural use. D'Antonio said that it will take two to three decades for the river to fully benefit from the retirement of farmland.

Fear and Loathing in the Rio Grande Project: The 2008 Settlement – Dr. Phillip King

Dr. Phillip King is an Associate Professor and Associate Department Head of the Department of Civil Engineering and Associate Director for the Institute for Energy and Environment at New Mexico State University. He has just been awarded a fellowship with the American Association for the Advancement of Science, which will provide him a sabbatical with the Engineering Director of the National Science Foundation. He also serves as the chair of the Dona Ana Soil and Water Conservation District's Board of Supervisors, and as the Governor's Designee on the New Mexico Soil and Water Conservation Commission. Dr. King has worked on regional water issues with the Elephant Butte Water District for the last 15 years.

The Rio Grande Project was authorized in 1905 and was completed in 1916. The purpose of the project was to irrigate farmland in southern New Mexico and western Texas near the Rio Grande. Elephant Butte Dam holds a reservoir capacity of around 2 million acre-feet. Caballo Reservoir is a regulating reservoir for flood and storm control. The water is used to irrigate the Rincon Valley. At Leesburg Dam, the water is used to irrigate the Upper Mesilla Valley. The Mesilla Dam irrigates the Lower Mesilla Valley. Past the El Paso Narrows, there is another diversion that irrigates the El Paso Valley. Below that is the International Dam which irrigates water to Mexico. The Elephant Butte Irrigation District (EBID) and the El Paso County Water Improvement District No. 1 (EP1) are allocated water *pro rata*, meaning the intent of the Rio Grande Project was to deliver water to the U.S. lands and the Rio Grande project equally, so people would have equal access to equal amounts of water. The project was financed by farmers mortgaging their farms. Therefore, the losses are shared amongst all water users. The Republic of Mexico also receives 60,000 acre-feet by a treaty consummated in 1906 for delivery. There are interstate and international water transfers by the Rio Grande Project.

The Rio Grande Compact, which was intended to divide the water of the Rio Grande among Colorado, New Mexico, and Texas, went into effect in 1938. Colorado's delivery obligation to New Mexico is based on index gages at the Rio Grande's headwaters; similarly, New Mexico's water delivery obligations to Texas are based on the Otowi gage. Since the farmers financed the Project, it was run very "top to bottom" by the Bureau of Reclamation, from the release at Elephant Butte down to the Farmer's Turnout. The federal government operated the Rio Grande Project as a single unit, and therefore did not pay attention to state lines. Elephant Butte Dam is the delivery point for water down to Texas. The Compact makes no provision for portioning water within the Rio Grande Project itself.

While there was a wet period in the 1940s, New Mexico had run through the storage at the reservoir and entered a severe drought by 1951, which lasted for 28 years. The Rio Grande Project farmers responded to the short water supply by developing a groundwater pumping capacity. The Bureau of Reclamation (BOR) was for water users to drill for groundwater to survive the drought.

The BOR kept records comparing the release at Caballo Dam and diversion and delivery. The relationship between release and diversion from the river is known as D2 in this presentation (see King's presentation, Slide 7), while the relationship of delivery between the farm headgate and release, known as D1. For example, if 600,000 acre-feet are released at Caballo, the relationship would suggest that 700,000 acre-feet would be diverted. Some of the minor components that contribute to the larger diversion include stormwater inflow, effluent water, and drain return flows (the largest component). Also, if 713,000 acre-feet of water is diverted into the system, only 393,000 acre-feet of water would be delivered to farmers. This is due to conveyance losses, primarily from canal seepage. This isn't necessarily a bad thing, as the groundwater is being recharged.

In 1979, the EBID paid off its construction loans to the BOR and signed the contract to operate the EBID. In 1980, EP1 did the same. In those contracts, the BOR became contractually obligated to develop an allocation and operating plan for the Rio Grande Project. The basin was declared in 1980 in direct response to the City of El Paso applying for groundwater well permits to drill 264 groundwater wells in the New Mexico portion of the Mesilla Valley, which New Mexico denied. A lawsuit filed by the City of El Paso ensued, with the dismissal of the case coming in 1991. Thereafter, New Mexico was barred from enforcing the Commerce Clause, which prohibited the exportation of New Mexico groundwater.

In 1997, the BOR filed a Quiet Title suit, claiming that while the irrigation districts have the title to the irrigation systems, the federal government owns the water. Since it is a small district with a big city, EP1 agreed with the lawsuit and filed a cross claim that said that the ad hoc allocation method the BOR had been using had been cheating them out of water that should have been theirs. Trilateral negotiations began in 1998, which collapsed in 2000. The suit was dismissed without prejudice in 2001. The next day, the EBID lawyers filed essentially the same suit in Federal District Court in Albuquerque since there were serious issues that needed to be dealt with and didn't want the suit to be taken to the Supreme Court.

From 1979 to 2002, there were full water allocations (3 acre-feet/acre) to the EBID, EP1, and Mexico. But, the drought returned in 2003, which created problems with groundwater depletions of surface water. From 2003 to 2006, the BOR employed an ad hoc allocation method, where Mexico's allocation was based on usable water in Project storage. The remaining diversion was divided between the EBID and EP1 in 57%/43% proportions, respectively. Unfortunately, this created the problem of being historically and substantially below the usual relationship of diversion and release due to increased groundwater pumping in New Mexico. This also was a problem in the case *Kansas* v. *Colorado* on the Arkansas River and *Texas v. New Mexico* on the Pecos River. As was mentioned previously, *Texas v. New Mexico* had a $15 million settlement and a $180 million compliance cost. The Rio Grande is a much higher value resource. Because of this, the EBID proposed a system where the allocation would be based on not the total actual available supply, but would look at water based on D2 ideal conditions and El Paso would get 43% of that amount. The 1951-1978 level of groundwater pumping was grandfathered in. One of the negotiating problems was that El Paso wanted to carry over water storage from previous years. Litigation appeared inevitable, but in early 2008 there was a last-ditch attempt to negotiate an allocation and operating agreement.

After a few weeks of negotiating, an agreement was made on February 14, 2008. The annual allocation was based on D2 conditions, with a D1 basis for the Mexico allocation, and a D2 basis for the EP1 allocation. New Mexico managed to base the allocations on the 1951-78 level of groundwater pumping. The Elephant Butte Irrigation District benefits from the Project's supply in excess of the D2 level if the release is greater than 600,000 acre-feet. El Paso did get excess carryover, which was equal to 60% of a full allocation. If the carryover exceeds 233,000 acre-feet for EP1, the excess carryover goes into the account of EBID, and the same happens when the EBID exceeds 306,000 acre-feet.

There were a few key points of the compromise. The EPCWID wanted and got carry-over protection from impacts of excessive groundwater pumping in New Mexico. The EBID wanted and got D3 as basins for the allocation of Project water regardless of origin, and accountability from the BOR. Both irrigation districts dismissed their lawsuits. The BOR is going to conduct an internal review of the operations of the El Paso Field Office under the Managing for Excellence program. Finally, the allocation and operating procedures are specifically codified, subject to change by a consensus agreement.

Because of the agreement, massive court, settlement, and compliance costs were avoided by the state of New Mexico. Resources can now be focused on improving productivity rather than litigation. There is also potential for the Lower Rio Grande to develop innovative conjunctive management of water resources.

Currently, the EBID is negotiating with the State of New Mexico over conjunctive management of surface water and groundwater. There is continuing coordination among water use sectors. There is also a focus on storm water management and capture, as since New Mexico's water delivery obligations to Texas are based on gages in Caballo Dam, the excess stormwater is available for use in the state.

Washington

Washington Water Law – Dave Nazy

Dave Nazy is a licensed geologist and hydrologist in the Washington State Department of Ecology Water Resources Program. His background includes experience as a water master, permit writer, hydrologist, cleanup site manager, and expert witness in State and Federal Courts. Currently, he is the Groundwater Specialist in the Water Resources Program's Policy and Planning Section in Olympia. In this role he provides support and oversight for project and policy initiatives in the State of Washington.

Chapter 90.03 of the Revised Code of Washington (RCW) is the water code for surface water rights. It was enacted in 1917, and established the prior appropriation system in the state, and that waters belonged to the public. It also established the "four-part test" for evaluating water right applications and making decisions on permit approvals – demonstration of water availability, no impairment of senior water rights, no detriment to the public welfare, and the need to put water to a beneficial use.

Chapter 90.44 RCW concerns the regulation of groundwater, and was enacted in 1945. It uses the Chapter 90.03 application processes and procedures (i.e., the four-part test). There is a permit exception for certain uses in the code, most of which are limited to 5,000 gallons per day. Exempt uses may not impair surface water rights. Roughly 7,000 new wells are drilled per year, and many are taking advantage of the permit exemption.

One of the major concerns in Washington is how climate change will affect the state's water supply. Nearly every glacier in the Cascade and Olympic Ranges have retreated in the past 50-150 years. In the Yakima River basin, the Climate Impacts Group predicted more winter rain, warmer temperatures, and lower winter snowpack, leading to higher winter streamflows, earlier snowmelt and a shift in the timing of peak runoff, and lower spring and summer flows. The affect on the salmon population is also a concern, as warm, low streamflow affects spawning and migration, and earlier peak flows affect smolt migration to the ocean.

Chapter 75.20 RCW, enacted in 1949, is the State Fisheries Code. It authorized the Washington Department of Fish & Wildlife to make recommendations concerning pending water right applications to the Department of Ecology. This was followed in 1969 by the Minimum Flows & Levels Act, which gave Fish & Wildlife more power to make recommendations for establishing flows to protect fish, wildlife, recreation and aesthetics.

As Washingtonians became more nervous about California taking water from the state, lawmakers enacted the Water Resources Act of 1971 (Chapter 90.54 RCW). The act sets the fundamental water policy for the state. It defines beneficial uses and and requires the Department of Ecology to establish in-stream flows. The Act also allows the Overriding Consideration of Public Interest (OCPI).

In the early 1990s, the Department of Ecology made a batch decision denying many groundwater applications based on in-stream flow protection or lack of water availability.

Chapter 90.82 RCW is the Watershed Planning Act. Under this act, the Department of Ecology provided watershed planning grants to fund the participation of many local groups in water decisions, including the establishment of in-stream flow rules across the state.

The evaluation of proposed groundwater withdrawals includes several factors including physical and legal availability and the possibility of impairment of senior water rights. The Department also uses conceptual and numeric models and uncertainty analyses. The state tries to examine groundwater and surface water as a single resource.

Sammamish Plateau Water and Sewer District's ASR Program – Scott Coffey

Scott Coffey is a professional hydrologist licensed in Washington working for the CDM consulting firm. While at CDM, Coffey has assisted clients with regional water supply planning, potable water production, well design, aquifer storage and recovery (ASR) permitting, and program implementation, water right applications, watershed/TMDL modeling, and expert witness testimony. He has been the Project Manager for the Sammamish Plateau Water and Sewer District's (SPWSD) ASR pilot program since its inception.

The ASR program started in 1993, and it conducted annual permitted operational tests from 1993 to 2005. In 2003, the State Legislature adopted new ASR rules and regulations, and the SPWSD became the first purveyor to receive long-term ASR Program Permits under these new regulations. The District received two 10-year permits. Since 2005, the SPWSD has been using the new permits and conducting pilot tests in various aquifers. Over 700 million gallons have been injected into the two aquifers (Cascade Valley and Plateau) since 2005.

The program operates in three phases. November to April is the injection phase. The storage phase is usually in May and lasts from one day up to one month depending on water demand and weather conditions. Finally, the recovery phase occurs from June to October, which is the peak demand period.

The District invested money in a three-dimensional numerical model that covers both of the aquifer systems. The model has 12 layers and over 30,000 computational nodes in three dimensions. This allows the creation of a denser cell grid in recharge and production well locations. It is calibrated to long-term monitoring data and ASR results. The model is used to simulate ASR injection, to quantify storage and recovery volumes, to track the fate of recharge water, and to compare estimates to those obtained from the analysis of manual data.

One of the Program injection aquifers is a shallow unconfined aquifer that was previously mined, i.e. its pumping rate exceeded its natural recharge. It is unconfined with boundaries above and to the sides. It has slow natural recharge that is slower than the actual production quantities coming out of it. Recharging this aquifer has been quite successful. The water levels are elevated post-recharge, and are maintained throughout the recovery period.

The pilot tests found three locations in aquifers that are suitable for storage. The seasonal unconfined portion (vadose) of the target aquifer works, due to pumping and seasonal lowering. Retained natural recharge in the overlying aquifer (Zone I) is also suitable. Saturated storage in the target aquifer (Zone II) may also be used. In Zone III and IV aquifers, the only storage that can occur is saturated storage in the phreatic layer. The area is a candidate for water quality improvement objectives.

The Program hopes to overcome the seasonal peak recharge versus peak demand dilemma. They also hope to increase storage in aquifers to eliminate the cost and aesthetic issues of above-ground storage. Improving groundwater quality is also important, especially in the area of reducing natural arsenic levels. Aquifer storage would also help to mitigate the increased cost of water in the summer. In the long term, the program objective would be to obtain additional seasonal (November –May) groundwater rights in a closed basin.

Idaho

Conjunctive Management in Idaho: A Scientific Perspective and Technical Tools – Dr. Gary Johnson

Dr. Gary Johnson is an Associate Professor in the Department of Geological Sciences in the University of Idaho. He describes himself as an engineer who has found a home in the Department of Geological Sciences. He is also the Associate Director of the Idaho Water Resources Research Institute (IWRRI). His primary research interests include surface and groundwater interactions. His presentation focused more on the science of conjunctive water management.

The Idaho Department of Water Resources (IDWR) has the regulatory authority for dealing with water appropriation in the state. The IDWR and the BOR has contracted with the IWRRI to provide technical assistance regarding groundwater-surface water interactions in the state of Idaho, with much of the work being focused on the Snake River basin in southern Idaho.

One complication of conjunctive management is that the impacts of pumping from or recharging water into an aquifer system do not follow flow lines, but propagate in all directions. Therefore, everyone pumping from a system affects everyone else to a small degree. A second complication is that the impacts of pumping are delayed and dampened. These complications make constructing rules difficult, as effects are hard to prove.

The eastern Snake River Plain is very large by comparison to many Montana systems. It is about 150 miles in length and 80 miles in width. It is a very productive basalt aquifer. Around 6 million acre-feet a year are discharged and recharged in the system. Recharge is predominantly from mountain areas and higher elevations in the north and east, as well as irrigated areas. Discharge is dominantly to the Snake River. The two major discharge areas are the Thousand Springs area and the American Falls area. Discharge increased in the first half of the 20th Century and decreased in the second half in both the Thousand Springs and American Falls areas. Since 1950, surface water irrigation systems have improved in efficiency, potentially decreasing recharge. Generally, the surface water right holders are the senior water right holders in the basin, which is typical in many Western states. Surface water irrigation is the largest component of recharge in the system, while river gains are the largest components of discharge.

To calculate steady-state river-aquifer response functions, the following equation is used:

River Effect = RF x Pumping Rate,

where *RF* = Response Function. This helps to calculate the long-term impacts of groundwater impacts on a surface system. The IWRRI created a model to show how much each reach of the Snake River is impacted by groundwater pumping. The model has identified to be impacted by groundwater pumping. State government has used this information to establish Ground Water Curtailment Areas. Another important facet of the modeling is the transient response functions, as sometimes the impact of groundwater pumping can affect stream reaches for decades.

The IWRRA has also built a Ground Water Rights Transfer Tool which is used by the IDWR to assess the impacts on Snake River reaches of water right transfer applications This tool requires the users to input a series of values for the amount of water used before the transfer and the planned use after the transfer.

In the Spokane Valley–Rathdrum Prairie basin of northern Idaho stretches from Coeur D'Alene, Idaho to the Spokane, Washington area. The Spokane River loses water to the aquifer in Idaho and gains water from the aquifer in Washington. Because of development in the Rathdrum Prairie, low flows of the Spokane River concern both Washington and Idaho. Modeling showed that groundwater pumping in the aquifer would show up as depletion within six months over the majority of the basin.

The IWRRA also developed a Spreadsheet Tool for water managers and users to use to approximate the results of groundwater flow modeling of the depletion effects on surface water resources in the Spokane Valley-Rathdrum Prairie area. The aquifer system was divided into a series of zones and the spreadsheet tool utilizes results from the models to predict the effect on interconnected surface water bodies when water is used from a specific zone.

Currently, the Idaho Water Resource Board is developing an aquifer management plan to rebalance the water budget of the aquifer. Also, the Board is trying to set up orders requiring the mandatory curtailment of pumping or mitigation plans.

Dr. Johnson said that the computer models in use have provided a scientific basis for conjunctive water management. The computer models also often provide the opportunity for more simple and intuitive tools.

Conjunctive Water Management in Idaho – Dr. Randy MacMillan

Dr. Randy MacMillan is the Vice President of Clear Springs Foods, Inc. He discussed challenges in dealing with the lack of water being delivered to his business.

Clear Springs Foods was founded in 1966 and is an employee-owned food company. It is the largest trout company in the world, producing 20-22 million pounds of fish per year. Because of water resources constraints, the business has been able to grow, but not in the United States.

Clear Springs Foods has received 300 ft^3/second (cfs) since its inception at the Box Canyon farm. However, the water flows to the Box Canyon farm have steadily decreased from around 430 cfs to 320 cfs over the past 50 years, or 20-30% depending on the spring source. Clear Springs Foods made two water delivery calls in 2005. Though an order was issued for curtailment and/or mitigation, very little water has been delivered. This has affected the water quality, along with the socioeconomic health of the region. Consequently, the conjunctive water management rules in place in Idaho are not working very well for Clear Springs Foods.

Dr. MacMillan said that conjunctive water management is a puzzle. Since water rights are property rights, they are held in high regard and are very valuable. If those property rights are not being protected (e.g., from groundwater pumpers), conflict will ensue. The State has also tried to meld water rights with property rights, which has created much conflict. The impacts of groundwater depletion can be acute, cumulative and difficult to predict. The need for conjunctive water management has only been recently recognized, so there is a question of how long the pumpers should be held accountable for depletion. Finally, some experts believe that the Eastern Snake Plain Aquifer (ESPA) is over-appropriated or fully allocated, which could have some very significant legal implications in Idaho.

The causes of water flow decline in Idaho are well known: groundwater pumping, changes in irrigation, and drought. The ESPA Comprehensive Aquifer Management Plan (CAMP) was created after the 2007 Water Summit. Its goal is a 300,000 to 600,000 acre-foot change in the water budget for the ESPA by managed and incidental recharges, groundwater to surface water conversions, reduction in demand, and weather modification.

MacMillan suggested several ways to improve the system. Conjunctive management rules should be made more specific. Water right administration is a property right issue, and should be separate from resource management. Achieving conjunctive water resources management will probably require a crisis.

Breakout Groups Summary

On June 9, 2009, the conference participants broke out into four groups that discussed an assigned topic and listed issues needing additional consideration. The assigned topics included: determining adverse affects and legal availability; determining the zone of influence for new wells; instream flows and conjunctive management; and DEQ public water supply and DNRC water right regulation pump requirements. A summary of the discussions can be found in the executive summary.

Conference Summation

Following the presentation of recommendations from the break-out groups, Dr. David Shively of the University of Montana's Department of Geography offered a summation of the conference.

Reviewing the welcome offered by John Tubbs, Shively noted that Tubbs' observation that, "Water in this Treasure State is our most valuable resource, but one that has been managed in a more cavalier manner than others," is an essential point for all Montanans. Next, Tubbs' point that states will have to work out the issues, practices, and policies surrounding conjunctive management for themselves without relying on much help from federal agencies, except for mitigation water from federal projects, plausible for the next several decades. Shively observed that information from the groundwater investigation and assessment programs of the MBMG is and will be critical to understanding the scale issues inherent in conjunctive management. The data from these programs will be a critical resource for water administrators, regulators, and users. It is noteworthy that such information needs have been emphasized and funded by the Montana Governor and Legislature.

In commenting on the first conference panel session concerning permit acquisition for new groundwater developments, instream flows, or municipal water right changes, Shively noted that the problems identified by the panelists primarily concern the difficulty and costs associated with the application process. While the DNRC is flexible and open to considering innovative methods and approaches, the permitting burden is clearly on the applicants, and sometimes the rules change midstream. For permit applicants, this creates and fuels uncertainty, increases expenses, fosters an atmosphere of distrust, and can promote taking the easy way out by some parties (such as in using the exempt well mechanism). The DNRC is in the unenviable position of interpreting and applying legislative intent, creating difficulties for the agency and applicants. The chronic lack of legislative attention to and funding for water resource issues, does not allow for the development of more progressive conjunctive management policies and practices in Montana.

In reviewing the information from the second panel of speakers about conjunctive management in other states, Shively offered the following observations. Information is critical and can be more basic, as in the case of the Lower Rio Grande Basin, or more complex as for the Snake River Plain, Rathdrum Prairie, Sammamish district, and elsewhere in Washington. Scale issues are very important.

Washington and New Mexico have decided that surface water and groundwater are generally always connected, which is the starting point for practicing conjunctive management. Following the approach of these states could help Montana in streamlining and simplifying the permitting process, allowing applicants to demonstrate the presence or lack of connectivity. It would also facilitate the development of water markets and mitigation banks to address our current and future problems regarding adverse affect.

New Mexico's use of alternative dispute resolution in the preliminary stages of the application process, is important for fundamentally dysfunctional water right systems. Also, incorporating other evaluative criteria, such as New Mexico does with the public interest criterion, is an important step in the right direction. Other states temper their prior appropriation systems with such criteria, and Montana should consider this. Active markets, mitigation banks, and other such measures or approaches can help to meet "priority of needs."

Uncertainty analysis, as it is employed by the Washington Department of Ecology, is also a very important tool to use in decision making – it helps us to gauge the "goodness of fit" of our proposals and decisions. Washington has a very progressive approach and Montana would benefit from examining it more closely. Lastly, in regard to Washington and its water user fees, it does not seem like a bad idea to ask the users of our most valuable treasure (aside from clean air) to recognize its value and support its good management, on a progressive sliding-scale fee formula of course!

References

Blomquist, William A., Heikkila, Tanya A. and Schlager, Edella. "Institutions and Conjunctive Water Management Among Three Western States." *Natural Resources Journal* **41**(3): Summer 2001.

Clark Fork River Basin Task Force. "Managing Montana's Water: Challenges Facing the Prior Appropriation Doctrine in the 21st Century." 2008.

Glennon, Robert. "High and Dry in the West: The Failure to Integrate Management of Ground- and Surface-Water Resources." *Southwest Hydrology:* July/August 2003.

Montana Bureau of Mines and Geology - MBMG. "Ground-Water Investigation Program." Accessed? Available online at: http://www.mbmg.mtech.edu/gwip/gwip.asp

Shovers, Brian. "Diversions, Ditches, & District Courts." *Montana: The Magazine of Western History.* 1 April, 2005.

Testa, Dan. "Montana Senate Passes Closed Basin Groundwater Bill." *New West*. 17 April, 2007.